WHAT IS CLAIMED IS:

1. A method of treating a surface of a sample, comprising the steps of:

generating a plasma in a treatment chamber;

applying an rf bias voltage to a stage on which a sample is placed independently of the generation of the plasma; and

on-off modulating an rf bias voltage to which a peak to peak voltage Vpp value larger than a Vpp value of a continuous rf bias voltage at which the same etch rate can be obtained is given.

2. A method according to claim 1, wherein the frequency of the rf bias voltage is set to 15 MHz or lower and the Vpp value of the rf bias voltage is set to 500V or higher.

3. A method according to claim 1, wherein the frequency of the rf bias voltage is set to be higher than 15 MHz and the Vpp value of the rf bias voltage is set to 800V or higher.

4. A method according to claim 1, wherein a duty ratio when the rf bias voltage is in the on state is set to 5 to 50%.

5. A method according to claim 1, wherein the sample surface treatment from the beginning till the end is divided into a plurality of steps and the rf

bias voltage is on-off modulated in at least one of the steps.

6. A method according to claim 5, wherein the plurality of steps are grouped into ~~the~~ first half in which a selectivity for a substance of an underlying film is relatively low and ~~the~~ latter half in which the selectivity is relatively high, and the rf bias voltage is on-off modulated at least in the steps of the first half.

7. A method according to claim 6, wherein the steps are switched according to time.

8. A method of treating a surface of a sample, comprising the steps of:

arranging a sample on a stage provided in a chamber;

continuously supplying an etching gas into the chamber and generating a plasma from the etching gas;

applying an rf bias of a frequency of 100 kHz or higher to the stage independently of the generation of the plasma; and

modulating the rf bias at a frequency of 100 Hz to 10 kHz to perform a surface treatment in which a minimum feature size is 1 μm or smaller to the sample.

9. A method according to claim 8, wherein the plasma is a high-density plasma having an electron

density of $1 \times 10^{10}/cm^{-3}$ or higher.

10. A method according to claim 8, wherein the etching gas is a mixed gas of chlorine and oxygen.

11. A method of treating a surface of a sample, comprising the steps of:

arranging a sample on a stage provided in a chamber;

continuously supplying an etching gas into the chamber and generating a plasma from the etching gas by using microwaves;

applying an rf bias ~~of~~ at a frequency of 100 kHz to 10 MHz to the stage independently of the generation of the plasma;

on-off modulating the rf bias at a frequency of 100 Hz to 10 kHz; and

setting a Vpp value of the rf bias voltage in the on state ~~is set~~ to 100V or higher, whereby ~~and~~ the surface of the sample is treated.

12. A method according to claim 11, wherein the plasma is an ECR plasma using microwaves of 2.45 GHz.

13. A method according to claim 11, wherein the plasma is an ECR plasma using microwaves of 100 MHz to 1 GHz.

14. A method of treating a surface of a sample, wherein when a sample having a pattern whose minimum

feature size is 1 μm or smaller held on a stage provided in a chamber by electrostatic chucking is etched with a plasma generated by continuously supplying an etching gas into the chamber,

the sample is treated by applying an rf bias to the stage independently of the plasma generation and time modulating the rf bias.

15. A method according to claim 14, wherein the electrostatic chuck of the sample is that of a dipole type.

16. A method of treating a surface of a sample, wherein when a sample having a film made of a material serving as a gate electrode on a gate oxide film having the thickness of 6 nm or smaller is etched with a plasma, an rf bias is applied to the sample and is also time modulated.

17. A method according to claim 16, wherein the film made of the material serving as the gate electrode is a polysilicon film or a multilayered film including a polysilicon film.

18. A sample surface treating apparatus comprising:

a stage which is provided in a chamber and on which a sample to be subjected to a surface treatment is placed;

etching gas supplying means for continuously supplying an etching gas for plasma generation into the chamber;

plasma generating means for generating a high-density plasma in the chamber;

a bias power supply for applying a bias voltage of 100 kHz or higher to the stage independently of the plasma generation; and

pulse modulating means for modulating the bias power supply at a frequency of 100 Hz to 10 kHz,

wherein the surface treatment in which the minimum feature size is 1 μm or smaller is performed to the sample placed on the stage.

19. An apparatus according to claim 18, wherein ~~the~~ amplitude of the rf voltage of 500V or higher can be generated when the frequency of the rf power supply is 15 MHz or lower, and ~~the~~ amplitude of the rf voltage of 800V or higher can be generated when the frequency of the rf power supply is higher than 15 MHz.

20. An apparatus according to claim 18, wherein the high-density plasma is generated by ~~either~~ an Electron Cyclotron Resonance system, ~~or~~ an Inductively Coupled Plasma system.

21. A sample surface treating apparatus

comprising:

a stage which is provided in a chamber and on which a sample to be subjected to a surface treatment ~~is~~ to be placed;

etching gas supplying means for continuously supplying an etching gas for plasma generation into the chamber;

plasma generating means for generating a high-density plasma in the chamber by using microwaves;

a bias power supply for applying a bias voltage of 100 kHz to 10 MHz to the stage independently of the plasma generation; and

pulse modulating means for modulating the bias power supply at a frequency of 100 Hz to 10 kHz,

wherein the amplitude of the rf voltage as the bias power supply is set to 100V or higher.

22. An apparatus according to claim 21, wherein said plasma generating means uses electron cyclotron resonance by using microwaves whose frequency is 2.45 GHz.

23. An apparatus according to claim 21, wherein said plasma generating means uses electron cyclotron resonance by using microwaves whose frequency is 100 MHz to 1GHz.